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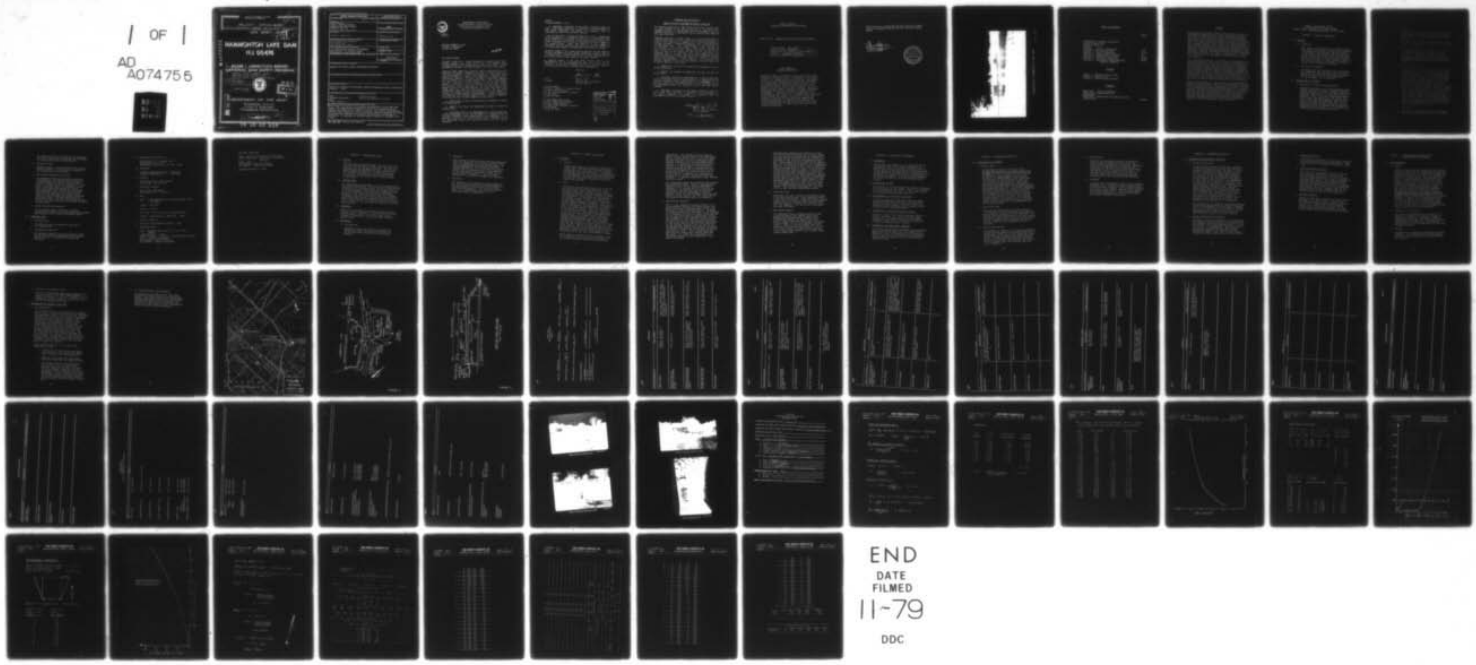

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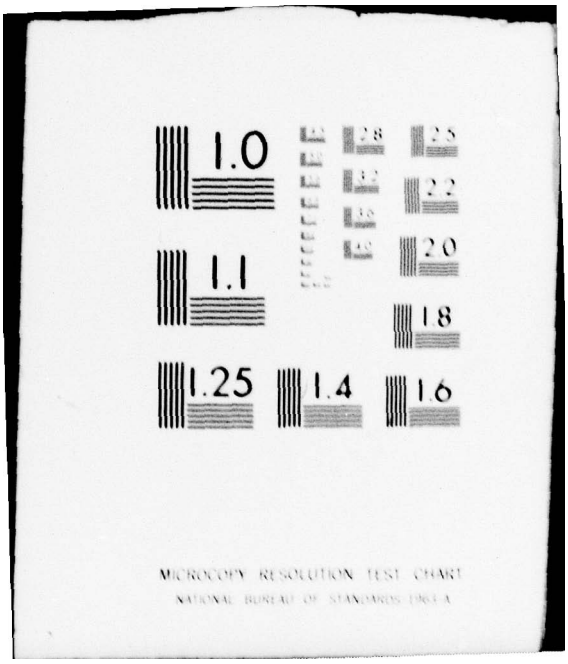
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HAMMONTON CREEK, ATLANTIC COUNTY
NEW JERSEY

LEVEL II

HAMMONTON LAKE DAM
NJ 00476

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Hammonton Lake Dam (NJ-00476). Atlantic Ocean Basin. Hammonton Creek, Atlantic County, New Jersey. Phase 1 Inspection Report.

(9) Final rept.,

(10) F. Keith /Jolls

(15) DACW61-79-C-0011

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

(11) Aug[redacted]1979

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Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Hammonton Lake Dam,N.J.
Slope
Visual Inspection
Structural Analysis
National Dam Inspection Act Report

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-D

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

26 SEP 1979

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Hammonton Lake Dam in Atlantic County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Hammonton Lake Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition. The dam's spillway is considered inadequate since 47 percent of the Spillway Design Flood - SDF - would overtop the dam. (The SDF, in this instance, is the 100 year flood). However, the calculated SDF would overtop the dam by only slightly more than 0.5 feet at the center of the dam and except for the probable erosion of the downstream face, it is felt that little other damage would occur should the crest be overtopped. For this reason and the dam's reduced hazard classification, no further studies or increase of spillway capacity are recommended. To insure adequacy of the structure, the following remedial actions should be completed within one year from the date of approval of this report:

a. Remove trees and brush on the downstream embankment to lessen the piping potential.

b. Backfill and regrade the downstream backslopes and seed the repaired areas.

c. The outfall ditch at the downstream toe of slope (to the right of the spillway where the 24" pipe and headwall are located) should be refilled to prevent further undercutting of the embankment. As an alternate, this drain (of unknown origin) could be extended to the main downstream channel and discharge directly into the natural streambed.

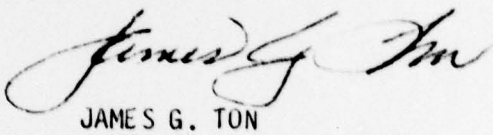
d. Additional instruction in dam safety inspections should be given to New Jersey Department of Transportation field personnel so that future inspections and reports are compatible with the requirements of the Division of Water Resources.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman William J. Hughes of the Second District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

HAMMONTON LAKE DAM (NJ00476)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 1 May 1979 by Louis Berger and Associates Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Hammonton Lake Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition. The dam's spillway is considered inadequate since 47 percent of the Spillway Design Flood - SDF - would overtop the dam. (The SDF, in this instance, is the 100 year flood). However, the calculated SDF would overtop the dam by only slightly more than 0.5 feet at the center of the dam and except for the probable erosion of the downstream face, it is felt that little other damage would occur should the crest be overtopped. For this reason and the dam's reduced hazard classification, no further studies or increase of spillway capacity are recommended. To insure adequacy of the structure, the following remedial actions should be completed within one year from the date of approval of this report:

a. Remove trees and brush on the downstream embankment to lessen the piping potential.

b. Backfill and regrade the downstream backslopes and seed the repaired areas.

c. The outfall ditch at the downstream toe of slope (to the right of the spillway where the 24" pipe and headwall are located) should be refilled to prevent further undercutting of the embankment. As an alternate, this drain (of unknown origin) could be extended to the main downstream channel and discharge directly into the natural streambed.

d. Additional instruction in dam safety inspections should be given to New Jersey Department of Transportation field personnel so that future inspections and reports are compatible with the requirements of the Division of Water Resources.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 25 Sep. 1979

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Hammonton Lake Dam Fed ID# NJ 00476

State Located New Jersey
County Located Atlantic
Coordinates Lat. 3937.9 - Long. 7446.3
Stream Hammonton Creek
Date of Inspection 1 May 1979

ASSESSMENT OF GENERAL CONDITIONS

Hammonton Lake is assessed to be in an overall good structural condition and is recommended to be downgraded to a significant hazard category. Overtopping of the major 4 lane highway crossing the dam would not appreciably increase the danger of loss of life or property damage downstream but collapse could endanger utilities and the dam structure. No detrimental findings were uncovered to render a hazardous assessment and further engineering studies are not recommended. Remedial actions recommended to be undertaken in the future are 1) remove trees and brush on the downstream slopes, 2) backfill regrade and construct slope protection along the downstream spillway wingwalls, 3) backfill and stabilize the outfall ditch below the 24" road drain to the right of the spillway and 4) rebuild the entrance to the auxiliary spillway.

This dam has an inadequate spillway capacity, being able to accomodate only 46% of the 100 year design flood.

F. Keith Jolls P.E.
Project Manager

OVERVIEW OF HAMMONTON LAKE DAM

MAY, 1979

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: HAMMONTON LAKE DAM FED ID# 00476

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia, to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Hammonton Lake Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Hammonton Lake Dam is a well-established State Highway Department roadway embankment approximately 325 feet long with a concrete drop inlet spillway located 120 feet from the northerly abutment. The 70 foot wide embankment carries White Horse Pike (Route U.S. 30) across the entire east shore of Hammonton Lake and forms the 13 foot high dam structure. The 7' x 12' concrete spillway culvert contains a set of removable timber flashboards and an abandoned sluice gate at the inlet. The sideslopes are variable but are approximately 1:1.

5. Location

Hammonton Lake Dam is located just south of the intersection of Route Route 206 and Pleasant Mills Road in the Town of Hammonton, Atlantic County, N.J.

The dam is built across Hammonton Creek which flows to the north into the Mullica River basin.

6. Size Classification

The maximum height of the dam is 12 feet and the maximum storage is estimated to be 325 acre-feet. Therefore, the dam is placed in the small size category as defined by the recommended Guidelines for Safety Inspection of Dams (maximum storage less than 1,000 acre-feet).

7. Hazard Classification

Based on the Corps of Engineers criteria and the fact that in the event of a failure, minor damage would be inflicted on downstream property and present little endangerment to human lives, the classification is downgraded to significant hazard. Failure would cause no appreciable damage except to the dam itself. The highway approaches at each end of the dam are level and afford ample sight distance to provide anyone accidently driving onto the overtopped roadway. However, immediately downstream, there are 2 or 3 residences and a sewage treatment plant situated near the edge of the floodplain and at Boyer Road, (approximately 3000 feet downstream) there is a substandard culvert and an adjacent low-lying home. Also, as near as could be determined, there may be water mains and other utilities within the embankment (where a failure might cause interruption of service).

8. Ownership

There are no available ownership records in the Division of Water Resources but because

the NJDOT initially constructed the embankment with the State R.O.W. it appears that the dam is owned by the State of New Jersey.

f. Purpose of Dam

Hammonton Lake is used principally for recreational purposes. A town park is situated at the south end of the reservoir.

g. Design and Construction History

The embankment and spillway were originally constructed in 1919 about 100 feet north of a revolutionary war period road and stone bridge in order to remove a sharp bend in the road. The older dam on the northerly alignment was abandoned but partially exists. White Horse Pike was widened to 4 lanes and reconstructed in 1952 on the same 6^{o} curve that forms the dam axis and centerline of roadway. The two auxiliary outlet structures were installed in 1919 and apparently not modified in 1952. Recently new guardrail and several road drainage curb inlets were installed by the NJDOT.

h. Normal Operating Procedures

At the present time, there are no formal operating procedures in effect except for periodic maintenance of the roadside drainage system.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of Hammonton Lake Dam is 2.7 square miles.

b. Discharge of Dam Site

The spillway capacity with the reservoir level at the top of dam is calculated to be approximately 150 cfs. No discharge records are available.

c. Elevation (above M.S.L.)

Top of dam - + 73 (bridge deck)
Recreation Pool - +69
Streambed at Center Line of Dam - +60±

d. Reservoir

Length of Recreation Pool - 5200 feet
Length of Maximum Pool - 5500 feet

e. Storage

Recreation Pool - 426 acre-ft.
Top of dam - 935 acre-ft.

f. Reservoir Surface

Top of dam - 184 acres
Recreation pool - 71 acres

g. Dam

Type - Earth embankment with concrete drop inlet spillway

Length - 325 feet

Height - 13 feet

Top width - 70± feet (57' in design plans)

Slopes: Downstream 1:1, Upstream - varies

Zoning - Unknown

h. Diversion and Regulating Tunnel - None

i. Spillway (Main)

Type - Concrete drop inlet at 7' x 12' RCC culvert
Length of weir - 5 feet
Crest Elevation - +69 M.S.L. (flashboards in place)
Gates - Timber flashboards
U/S Channel - None (reservoir)
D/S Channel - Natural streambed

Spillway (Auxilary)

Type - 24-inch reinforced concrete pipe
Invert Elevation - +68.5 M.S.L. (partially blocked)
Gates - None
U/S Channel - None (reservoir)
D/S Channel - Natural streambed

j. Regulating Outlets - None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The only design data available for review were the 1919 and 1952 as-built roadway plans for the construction of the pavement widening. The work was designed and the construction supervised by the State Highway Department. No structural plans for the main spillway culvert were located and it could not be determined under which contract it was built.

2.2 CONSTRUCTION

No information was available as to who accomplished the road construction. From the lack of differential settlement, it is assumed that the 60 year old fill is well compacted. The underlying foundation soils are recent alluvium overlying stratified swamp deposits. The silty clays and sands are variable in composition with inter-mixed gravel and Cohansey sands with good internal drainage characteristics. The alluvial material is generally less than 10 feet thick. Depth to the Pre-Cambrian bedrock is greater than 100 feet.

2.3 OPERATION

There are no records of construction modifications and the present structure is essentially as it was reconstructed in 1952. As a dam, there are no records of inspections and the spillway operates uncontrolled.

2.4 EVALUATION

a. Availability

Sufficient engineering data is available to conduct the following assessment except for any specific data relating to the spillway culvert.

b. Adequacy

The original engineering data reviewed indicates that the structure was carefully designed and built in accordance with the design plans. As the workmanship was supervised by the State Highway Department, it is believed that it was carried out in a proper manner (as evidenced by the satisfactory condition of most of the exposed culvert elements). The available information is therefore deemed to be adequate.

c. Validity

The validity of the available design plans is not questioned and based on field observations, the data appears valid insofar as the dam's existing configuration. In view of the ownership, it is accepted without recourse to gathering further information.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of the dam was conducted on 1 May 1979. The water level at the time of inspection was a few inches above the timber flashboards and flowing freely. A reinspection was conducted on 13 July and revealed that the 24-inch auxiliary spillway had been partially cleaned (at the prior inspection, this was completely blocked).

b. Dam

In general, the dam was found to be in an old but satisfactorily stable condition. The reservoir water level appears to be fairly constant during most periods (except for heavy rainstorms) and the outflow is fairly uniform. The embankment is well compacted and there is no evidence of any seepage. It appears the ground water table is very close to the downstream channel natural streambed. There is ample evidence of various repaving and patching, but the attitude of the guardrail, telephone poles and curbs indicate that there has been no settlement problems. There are several 2 to 10 inch trees on the downstream embankment slope and several areas where the surface has sloughed out. The surface runoff from the roadway pavement appears to be a continuing maintenance problem but appears to be under control at the present time. The shoulder subgrade has failed in several areas, especially over the main culvert spillway but this is of a minor nature. The entire upstream face of the embankment appears to be protected with concrete and stone riprap but the limits could not be discerned due to the heavy overgrowth of weeds.

About 100 feet southeast of the spillway, there is a headwall and 24" drainage pipe outlet in the downstream ditch between the old and new

embankments. The location of the inlet or origin of this outlet could not be determined but the discharge has cut a 6 to 8 foot deep channel into the toe of the embankment which extends northwest into the main downstream channel. It could not be determined whether the water in the bottom of this ditch was seepage through the dam or leakage from the drain (which apparently runs parallel to the centerline of dam, at least in the vicinity of the outlet). However, this outlet has scoured out a sizeable depression below the headwall. It appears substantial flows emanate from this drain.

The downstream slopes are irregular and covered with brush and weeds. There is considerable surface erosion at the culvert downstream wingwalls. It appears the 1952 widening was extended on the upstream face and the back-slopes have not been regraded in several decades. Near the left abutment there may have been an earlier culvert but this could not be verified by the design plans or inspection.

c. Appurtenant Structure

The 7' x 12' concrete spillway culvert is in good condition and has only minor cracks and spalls along the weathered edges of the inlet and tops of outlet retaining walls. Although no detailed plans were available, it is believed this structure is built on timber piles and due to its size and length is structurally stable. The alignment of the underside of the top slab and wingwalls is true and the wingwalls show no signs of tilting or differential settlement. It was noted that the year 1937 was imprinted on the concrete headwall over the top of the flashboard gate slab at the entrance (although the culvert is believed to have been originally installed in 1919). This is apparently the date the gate and/or gate housing structure was built. It could not be determined if a sluicegate exists or still functions. The wheel is missing.

The auxiliary concrete pipe spillway to the left of the main sluiceway has an invert about 6 inches below the present top of flashboards and consists of a 24-inch RCP laid overtop and slightly to the side of an abandoned 48-inch RCP. Both extend the full width of the embankment but the lower pipe appears to be completely buried. At the time of the initial inspection, both were blocked but in July, the 24" pipe was cleared and was flowing freely. A small downstream stilling basin immediately below this outlet has also been recently cleared of debris and extends down to the abandoned stone masonry culvert which originally carried the Hammonton Creek under the pre-1919 road alignment. This abandoned structure has a small (36") outlet. The old roadway crest is some five feet above the streambed which partially blocks the discharge. The overflow discharges to the right into the main spillway downstream channel.

d. Reservoir Area

Hammonton Lake has a stable, well-defined shoreline which extends over a mile southwest where a town park is located. Above the gently sloping shores there are numerous homes and the Kessler Hospital which is located just upstream from the left abutment. All are 8 to 15 feet above dam crest elevation.

e. Downstream Channel

The Hammonton Creek streambed below the dam passes through a flat, marshy area with a meandering braided channel, blocked with considerable amounts of debris and fallen timber. About 3000 feet downstream, the creek flows through a 16 x 6 feet culvert at Boyer Street. There is little evidence that this structure has recently been flooded. The low-lying river valley is undeveloped except for 2 or 3 homes which appear at or slightly above normal flood stage.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not observed by the inspection team. The roadway embankment and appurtenant surface drainage structures are part of the District Four Department of Transportation normal operation and maintenance responsibilities. No manuals or instructions for the regulation of flow were available. It could not be determined who exercises control over the spillway flashboards.

4.2 MAINTENANCE OF DAM

Maintenance of the embankment and culvert structure are carried out by the NJDOT. There is no evidence of any maintenance or repair of the intake structure having been undertaken recently.

4.3 MAINTENANCE OF OPERATING FACILITIES

The only operational facilities are the timber flashboards and they apparently have not been pulled in several years. The gate housing has apparently been abandoned and it appears no one is maintaining this appurtanence.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

Presently, there is no formal warning system in effect. However, the State and County Road Supervisor's personnel monitor the dam during periods of heavy flow as the dam is located on a heavily travelled State highway.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The present operational procedures and safeguards during periods of heavy flow are deemed to be adequate in view of the period of time required for the dam to be overtopped and the relatively large retention capacity of the upstream zone around the lake.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

In accordance with the criteria in the Recommended Guidelines for Safety Inspection of Dams, it has been determined that the dam at Hammonton Lake is small in size and is placed in the significant hazard category. Accordingly, the spillway design flood (SDF) was selected by the inspection team to be the 100-year frequency event. The inflow hydrograph was calculated using precipitation data from Technical Paper 40 and NOAA Technical Memorandum NWS Hydro-35. The inflow hydrograph and routing through the reservoir were performed utilizing the HEC-1 computer program. This produced a peak inflow to the reservoir of 6,190 cfs which when routed, was reduced significantly to only 324 cfs. The spillway capacity before overtopping occurs is approximately 150 cfs and thus will accommodate 46% of the design storm.

b. Experience Data

There was no information available (hearsay or otherwise) to the inspection team concerning any historical flooding at this structure. It appears that any overtopping in the past merely closed the roadway for a brief period and would do little damage, except possibly to the dam itself. There are no streamflow records available.

c. Visual Observations

The purpose (or cause) of the recent unblocking of the 24-inch auxiliary spillway could not be determined. From the initial inspection, this outlet appeared to have been blocked for many years. It was noted that the main spillway capacity is severely restricted by the shallow 1'-6" clearance above the stoplogs when all are in position.

d. Overtopping

Based on the appended hydraulic calculations, the spillway is unable to pass the design flood without overtopping of the dam. Although there is no evidence that the dam has been overtopped in the past, the design storm would overtop the crest by about one half foot. It was noted that the roadway is on a 600' sag vertical curve and the overtopping would be concentrated in the vicinity of the spillway.

e. Drawdown

It would take approximately three days to dewater Hammonton Lake. Drawdown could be accomplished by removing the stoplogs to the spillway entrance sill which, from probing, appears to be slightly above the culvert invert. The reservoir could be lowered approximately 8 feet by this means with further drawdown impossible.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Based upon the existing conditions inspected in the field and review of the 1919 and 1952 highway construction plans, the dam is judged to be in a relatively good condition except for the erosion of the downstream slopes in the vicinity of the spillway and the deeply incised ditch below the parallel road drain to the right of the spillway. The embankment is very wide with respect to its height and accordingly, its stability is adequate in the opinion of the inspection team. The slightly lower embankment of the earlier roadway additionally buttresses the downstream side of the embankment. No evidence of seepage was observed. The principal concrete spillway is in satisfactory condition and is believed to be constructed on timber piling although this could not be verified. The mechanical gate appears to be inoperable.

The entrance of the recently unplugged auxiliary 24" RCP sluiceway remains partially buried and there is no headwall at the entrance. Because this pipe is laid right on the side of a lower plugged 48" RCP, a potential for piping at this interface could be a future problem.

b. Design & Construction History

Although no design computations were available, the concrete spillway culvert is of modest span and displays only minor cracking after 60 years of service. Its structural stability, in spite of its age, is satisfactory. The headwall, maintenance platform and flashboards were apparently added to the inlet in 1937 and are in about the same condition as the box culvert.

c. Operating Records

No records are available but the main sluiceway operates satisfactory for normal flows. There is no record of any damaging overtopping since 1940.

d. Post Construction Changes

The only post construction changes since the 1952 widening and repaving have been the addition and modification (at various times) of the highway apputenances, such as guardrail, curb and curb inlets. The roadway pavement drainage and channelization appears to be a continual maintenance problem but is presently causing only minor erosion to the upstream dam face and can easily be repaired (due to the superelevation of the pavement, most of the surface run-off flows in this direction).

e. Seismic Stability

Hammonton Lake Dam is located in Seismic Zone 1 and due to its large width to height ratio has adequate stability under dynamic loadings as it is very stable under static loading conditions. As previously stated, the old roadway embankment downstream acts over most of the length of dam as a stabilizing toe berm.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ PROPOSED REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, the Hammonton Lake Dam is classified as being in a good overall structural condition although the spillway is incapable of passing the design flood. The embankment was built of unknown composition but due to its width to height ratio and lack of any visible evidence of seepage, is believed to be of a sufficient impermeable condition to withstand all normally anticipated hydraulic heads. The present spillway capacity is inadequate and does not meet the requirements of the Recommended Guidelines for Safety Inspection of Dams, being able to accommodate 46% of the design flood as calculated by Corps of Engineers criteria. However, the calculated SDF would overtop the dam by only slightly more than 0.5 feet at the center of the dam and except for the probable erosion of the downstream face, it is felt that little other damage would occur should the crest be overtopped.

b. Adequacy of Information

The information gathered for the Phase I inspection is deemed to be adequate regarding structural stability. However, no recent surveys have been made and recorded performance information is non-existent. The dam has apparently never been inspected by the Division of Water Resources.

c. Urgency

No urgency is attached to implementing further studies. It is recommended that the remedial measures enumerated below be accomplished in the future.

d. Necessity for Further Study

Due to the downgraded significant hazard classification and the fact that little property damage is foreseen in case of a failure, further engineering studies under the purview of P.L. 92-367 are deemed unnecessary.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Recommendations

On the basis of the visual inspection, improvements to the principal spillway are not warranted. The embankment areas at the ends of the culvert wingwalls on the north side should be regraded and protected with concrete asphalt slope protection. The auxiliary spillway is very inefficient and should have its entrance cleared and protected with a headwall or concrete slope paving to prevent piping action at the interface between this pipe and the abandoned 48" RCP upon which it rests. The 48" pipe should be safe-loaded with sand or lean concrete fill and have its entrance and exit plugged. Consideration could be given to building a three-sided concrete box inlet and headwall at this entrance and utilizing both pipes as auxiliary outlets.

Other remedial measures to be taken under advisement include:

1) removal of the trees, brush and major root systems on the downstream embankment to lessen the piping potential

2) Backfill and regrade the downstream backslopes and seed the repaired areas.

3) The outfall ditch at the downstream toe of slope (to the right of the spillway where the 24" pipe and headwall are located) should be refilled to prevent further undercutting of the embankment. As an alternate, this drain (of unknown origin) could be extended to the main downstream channel and discharge directly into the natural streambed.

b. O & M Maintenance and Procedures

No additional procedures other than those presently in effect appear to be warranted. However, additional instruction in dam safety inspections should be given to NJDOT field personnel so that future inspections and reports are compatible with the requirements of the Division of Water Resources.

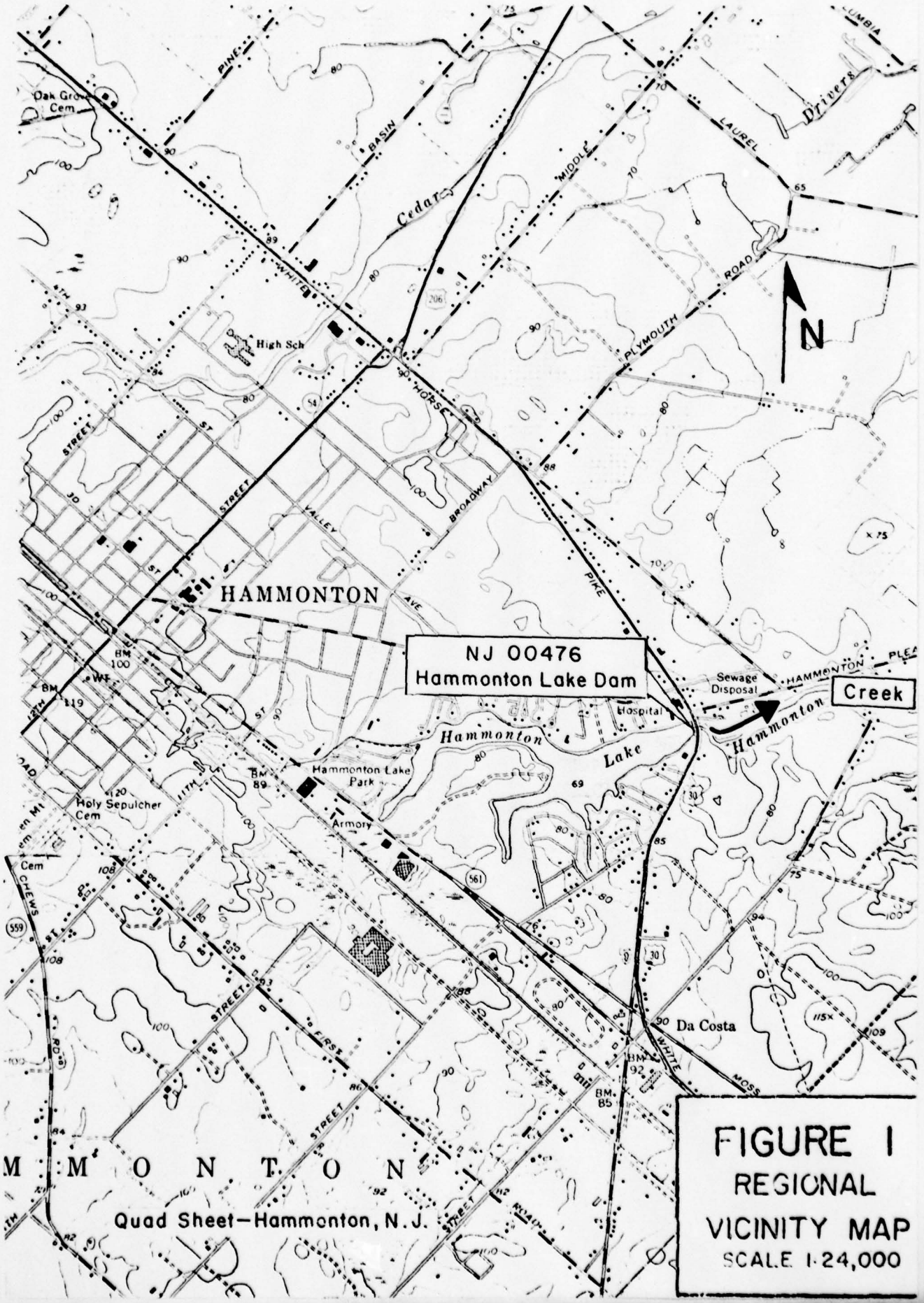
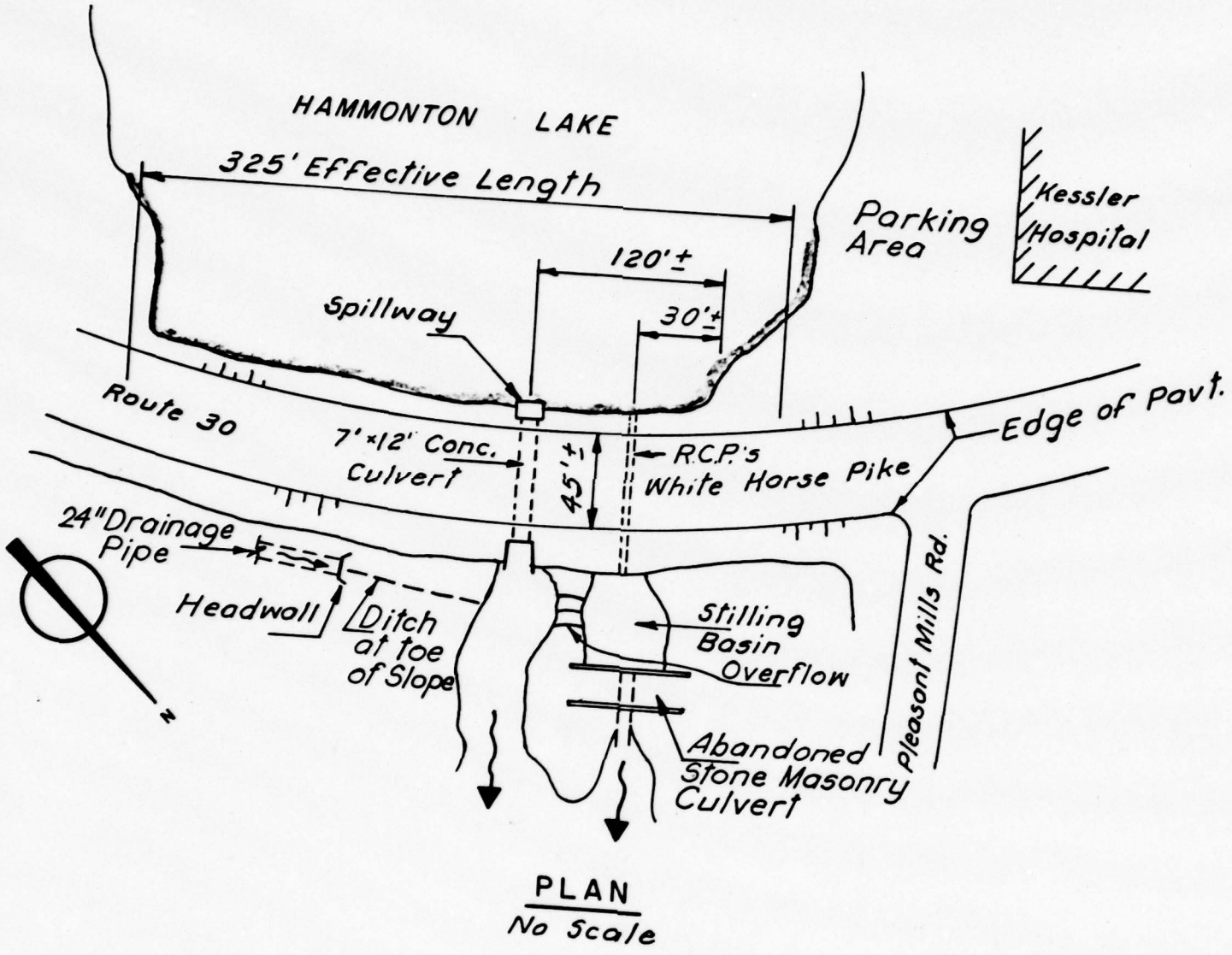
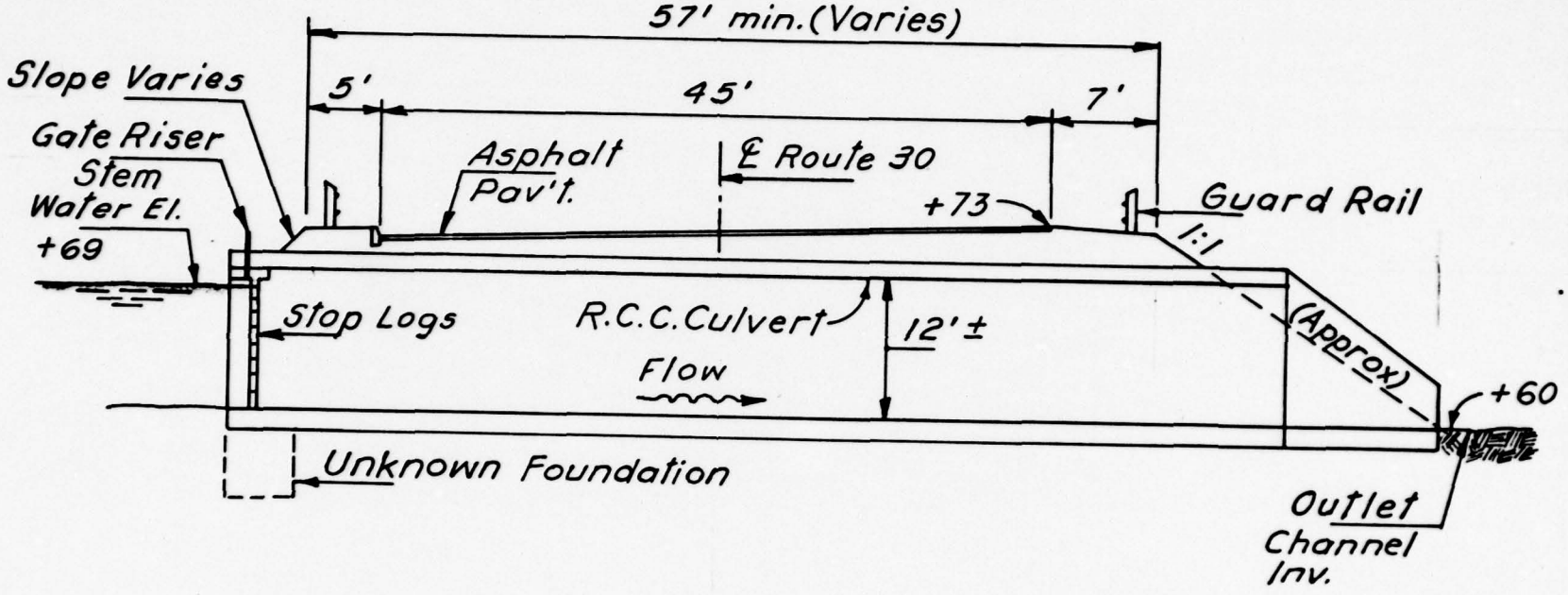


FIGURE 1
REGIONAL
VICINITY MAP
SCALE 1:24,000



PLAN
No Scale

FIGURE 2



SECTION THRU SPILLWAY

Not to Scale

FIGURE 3

Check List
Visual Inspection
Phase 1

Name Dam Hammonton County Atlantic State N.J. Coordinators NJDEP

Date(s) Inspection 1 May 79 Weather Clear Temperature 18°C

Pool Elevation at Time of Inspection 69± M.S.L. Tailwater at Time of Inspection 60± M.S.L.

Inspection Personnel:

L. Baines D. Mulligan

K. Jolls

K. Greenfield

L. Baines Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Several observed in roadway pavement.	Guard rail appears much newer than pavement. Overall condition of road, curb and guardrail satisfactory.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	Sideslopes heavily overgrown with brush and trees.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Minor erosion on upstream corner at left abutment front slopes eroded from roadway drainage.	Major undercutting in toe of slope ditch to right of spillway.
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Four lane asphalt roadway curbed on both sides.	Road on 600' sag vertical curve. Approach grades flat (1.5%±).
RIPRAP FAILURES	Entire front face covered with riprap.	Condition: excellent.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
Excessive shrub growth, trees, etc.	Some trees on downstream slopes (2 to 10")	Heavy secondary growth on back-slopes near left abutment.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Satisfactory. Steep back-slopes near left abutment (approx. 1H:1V). Front slopes near abutments very flat.	
ANY NOTICEABLE SEEPAGE	* Yes-approximately 50' to left of main spillway (could be groundwater)	Entrance to 36" Ø and 1-24"Ø R.C.P. completely blocked with debris. However, at 7/12/79 inspection entrance had been cleared.
STAFF GAGE AND RECORDER	None	
DRAINS	* At second inspection, water was result of buried pipe which was previously blocked.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Minor weathering (No structural cracking observed).	Box culvert (7' x 12')
INTAKE STRUCTURE	Concrete weir. Built in 1937 from date on top slab. Gate stem and riser located on top slab.	Stem old and rusted. Inoperable Wheel and top gear gone. Type of gate and position could not be determined. Timber flashboards. Concrete recesses were noted.
OUTLET STRUCTURE	Two parallel concrete wingwalls. Satisfactory condition.	
OUTLET CHANNEL	Meandering, braided channels, heavily wooded.	Flow from auxiliary 24" outlet overflows into main channel.
EMERGENCY GATE	None	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	5' concrete narrow crested weir (with 1 foot shoulder on each side on each side of stoplog slots)	Intake built in 1937. No cracking - good condition.
APPROACH CHANNEL	Reservoir discharges over weir.	
DISCHARGE CHANNEL	Narrow (10'-15'). Clear of debris.	
BRIDGE AND PIERS	None.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No obstruction. Heavily wooded.	
SLOPES	Very regular terrain. Heavy secondary growth.	Old roadway embankment immediately below dam.
APPROXIMATE NO. OF HOMES AND POPULATION	2-3 homes at flood elevation.	Little potential flooding hazard.

NOTE:

Downstream: 16'x6' box culvert at Boyer Street (See quad sheet). Also a sewage treatment plant- slightly above flood elevation.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Flat, grassed slopes.	Picnic area behind hospital (first floor of hospital 8'-10' above top of dam).
SEDIMENTATION	Unknown. Sandy bottom observed at face of dam. Water only 3'-4' deep.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL		
APPROACH CHANNEL		
DISCHARGE CHANNEL		
BRIDGE AND PIERS		
GATES AND OPERATION EQUIPMENT		

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS		
DRAINS		
WATER PASSAGES		
FOUNDATION		

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES		
STRUCTURAL CRACKING		
VERTICAL AND HORIZONTAL ALIGNMENT		
MONOLITH JOINTS		
CONSTRUCTION JOINTS		

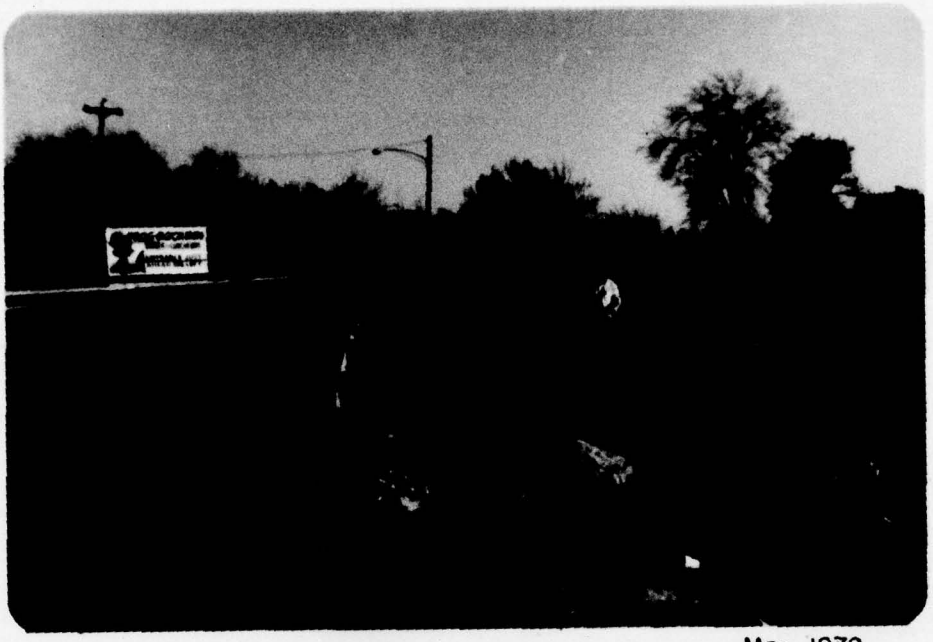
CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Not available
REGIONAL VICINITY MAP	Available (U.S.G.S. Quad)
CONSTRUCTION HISTORY	Not available
TYPICAL SECTIONS OF DAM	None available
HYDROLOGIC/HYDRAULIC DATA	None available
OUTLETS - PLAN	Not available
- DETAILS	Not available
-CONSTRAINTS	Not available
-DISCHARGE RATINGS	Not available
RAINFALL/RESERVOIR RECORDS	None available

ITEM	REMARKS
SPILLWAY PLAN	None available
SECTIONS	None available
DETAILS	None available
OPERATING EQUIPMENT PLANS & DETAILS	None available

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	None available
DESIGN COMPUTATIONS	None available
HYDROLOGY & HYDRAULICS	None available
DAM STABILITY	None available
SEEPAGE STUDIES	None available
MATERIALS INVESTIGATIONS	None
BORING RECORDS	None available
LABORATORY	None available
FIELD	None available
POST-CONSTRUCTION SURVEYS OF DAM	Highway plans available (N.J.D.O.T.)
BORROW SOURCES.	Unknown

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	Modifications to roadway only
HIGH POOL RECORDS	None available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available
PRIOR ACCIDENTS OR FAILURE OF DAM	Unknown
DESCRIPTION	None available
REPORTS	None available
MAINTENANCE OPERATION RECORDS	Not available



View of Crest Looking South May, 1979

View of Auxiliary Spillway Outlet July, 1979

July, 1979

View of Spillway Intake Structure

July, 1979

View of Spillway Outlet

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 2.7 sq. mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 69 M.S.L. (426 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 73 M.S.L. (935 acre-feet)

ELEVATION MAXIMUM DESIGN POOL:

ELEVATION TOP DAM: +73 M.S.L.

CREST: 4-lane paved roadway

a. Elevation 69 M.S.L.
b. Type 1-sided drop inlet
c. Width 2"
d. Length 7'
e. Location Spillover 120' from left abutment
f. Number and Type of Gates Unknown

OUTLET WORKS: Vertical lift sluicegate - size unknown

a. Type Unknown
b. Location Main spillway
c. Entrance inverts Unknown
d. Exit inverts Unknown
e. Emergency draindown facilities None except stoplogs

HYDROMETEOROLOGICAL GAGES: None
a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 150 cfs (spillway capacity).

BY D.J.M. DATE 7-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A1 OF
CHKD. BY DATE HAMMONTON LAKE DAM PROJECT C234
SUBJECT

Time of concentration :

length along watercourse to divide = 0.9 miles = 4752 feet

ΔH = 31 feet $\therefore$ Slope $= \frac{31 \times 100}{4752} = 0.65\ \%$

By California Culverts Method :

$$t_c = \left(\frac{11.9 \times 0.9^3}{31}\right)^{0.385} = 0.61 \text{ hours}$$

Alternate Method (a) :

assume velocity = 2 feet s^{-1}

$$\therefore t_c = \frac{4752}{2 \times 3600} = 0.66 \text{ hours}$$

Alternate Method (b) :

$$t_c = 0.00013 \times \frac{4752^{0.77}}{0.0065^{0.385}} = 0.61 \text{ hours}$$

take average $t_c = (0.61 + 0.66 + 0.61)/3 = 0.63$ hours

$$t_p = \frac{0.25}{2} + 0.6 \times 0.63 = 0.51 \text{ hours}$$

$$Q_p = \frac{484 \times 2.7}{0.51} = 2562 \text{ cfs}$$

BY D.J.M. DATE 7-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A2 OF
CHKD. BY ____ DATE ____ HAMMONTON LAKE DAM PROJECT C234
SUBJECT ____

Unitgraph :

Time (hours)	T/Tp	Dimensionless Ordinate (DO)	Q (cfs) = Qp × DO
0.25	0.49	0.41	1051
0.50	0.98	0.99	2537
0.75	1.47	0.68	1742
1.00	1.96	0.33	846
1.25	2.45	0.16	410
1.50	2.94	0.08	205
1.75	3.43	0.04	102
2.00	3.92	0.02	51
			Σ 6944

Check $\frac{6944 \times 12 \times 3600}{2.7 \times 5280^2 \times 4} = 1$ So O.K.

BY D.J.M. DATE 7-79. **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A3 OF
CHKD. BY DATE HAMMONTON LAKE DAM PROJECT 6234
SUBJECT

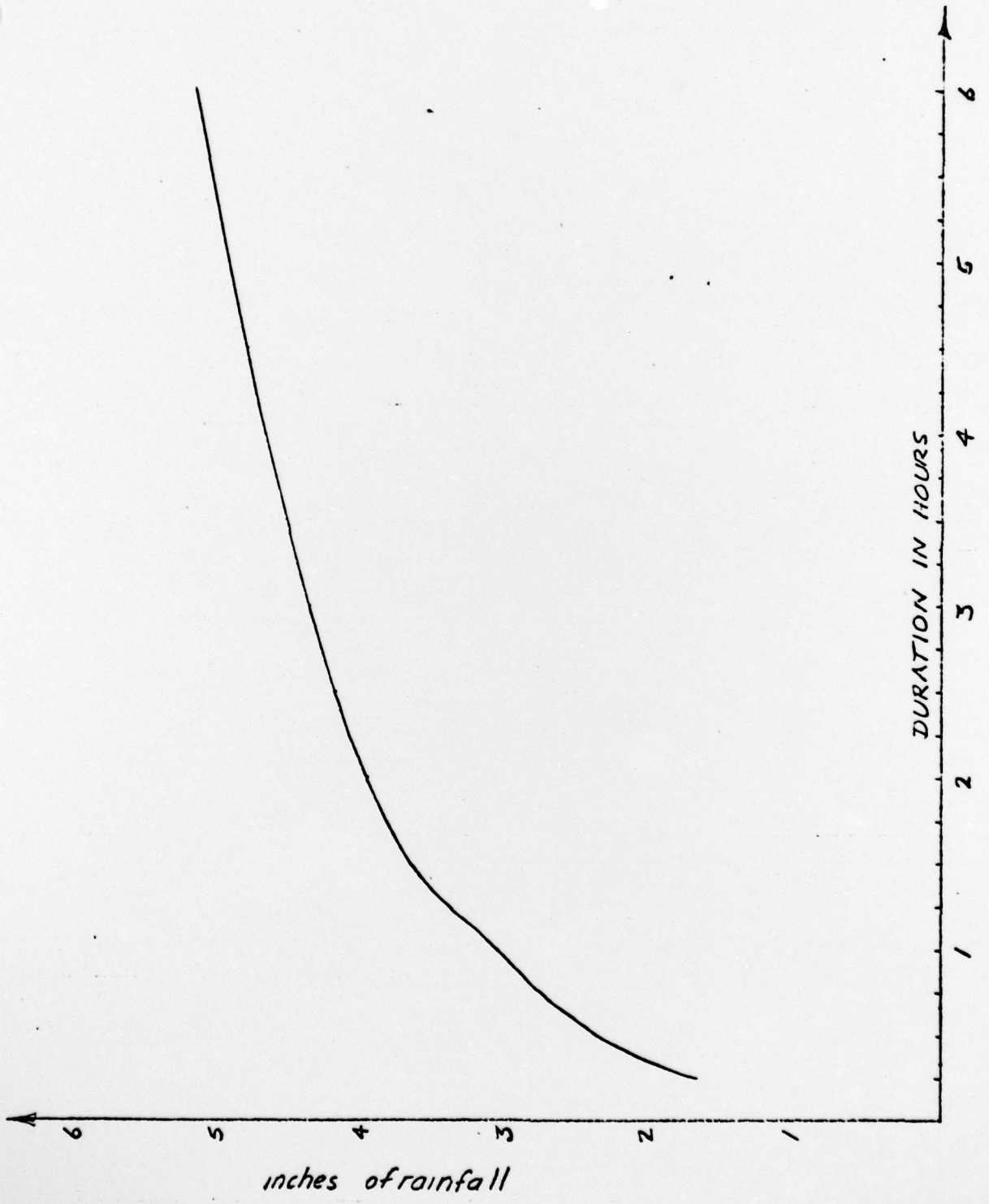
Precipitation data from T.P. 40 & NOAA Technical Memo N.W.S. Hydro-35. (see depth duration curve overleaf)

Time	Precipitation	Δ	Rearrange Δ
0.25	1.7	1.7	0.06
0.50	2.4	0.7	0.06
0.75	2.8	0.4	0.07
1.00	3.1	0.3	0.07
1.25	3.4	0.3	0.09
1.50	3.7	0.3	0.09
1.75	3.86	0.16	0.11
2.00	4.00	0.14	0.14
2.25	4.11	0.11	0.30
2.50	4.22	0.11	0.30
2.75	4.31	0.09	0.70
3.00	4.40	0.09	1.70
3.25	4.49	0.09	0.40
3.50	4.57	0.08	0.30
3.75	4.64	0.07	0.16
4.00	4.71	0.07	0.11
4.25	4.78	0.07	0.09
4.50	4.84	0.06	0.08
4.75	4.90	0.06	0.07
5.00	4.96	0.06	0.06
5.25	5.02	0.06	0.06
5.50	5.08	0.06	0.06
5.75	5.14	0.06	0.06
6.00	5.20	0.06	0.06

BY D.J.M DATE 1-14 SUBJECT SHEET NO. A4 OF

CHKD. BY DATE DEPTH DURATION CURVE JOB NO. C227

T.P. 40 & NOAA TECHNICAL MEMO. NWS HYDRO-35



BY D.J.M. DATE 7-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A 5 OF
CHKD. BY ..... DATE ..... HAMMONTON LAKE DAM PROJECT C 234
SUBJECT .....

Spillway discharge:

flow over spillway as weir L = 5'

H	C	Q
0		
1	3.1	16
1.5	3.1	28
2	3.1	44

flow over spillway as weir L = 2'

H	C	Q
0.33	3.1	1
0.83	3.1	5
1.33	3.1	10

Culvert flow
Area = 13.8 ft²

H	Q
3	105
4	122
5	136
6	149
7	161
8	172
9	183

flow through 24" pipe

H	Q
0	
0.83	13
1.33	16
1.83	19
2.83	23
3.83	27
4.83	30
5.83	33
6.83	36
7.83	39
8.83	41

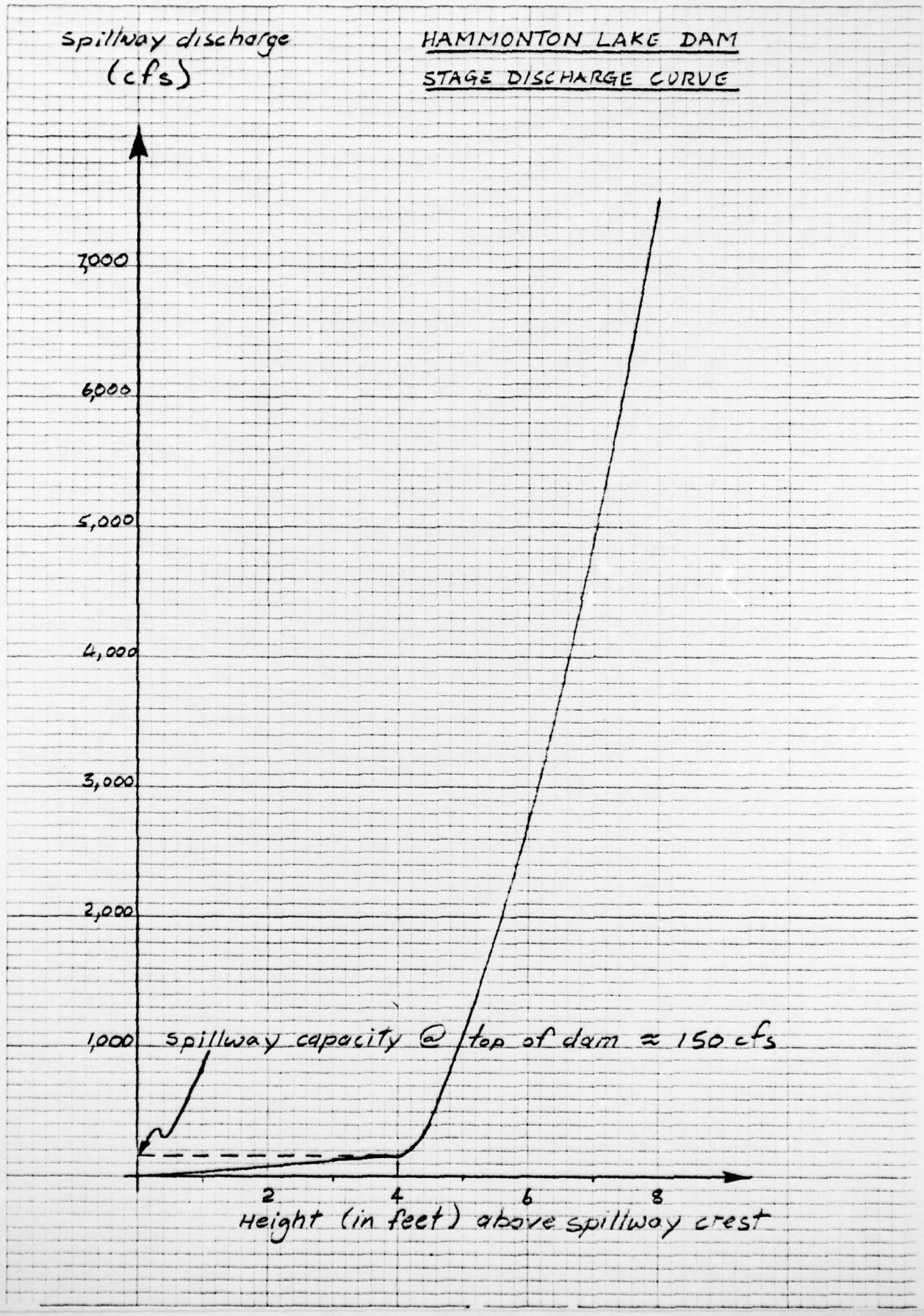
flow over dam L = 325'

H	C	Q
1	2.8	910
2	2.8	2574
3	2.8	4728
4	2.8	7280
5	2.8	10174

Σ Q (cfs)

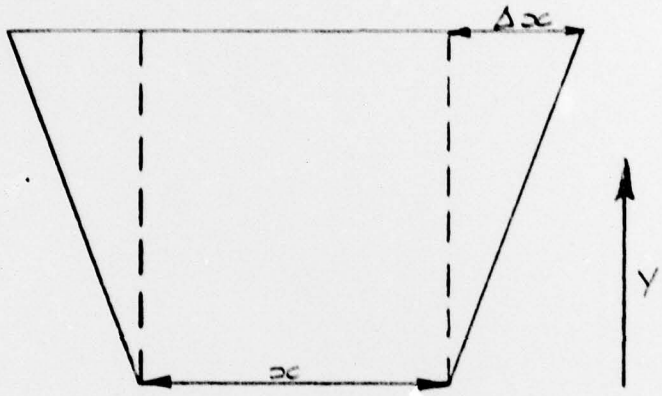
H	Q
0	
1	30
1.5	49
2	73
3	128
4	149
5	1076
6	2756
7	4925
8	7491
9	10398

HAMMONTON LAKE DAM
STAGE DISCHARGE CURVE



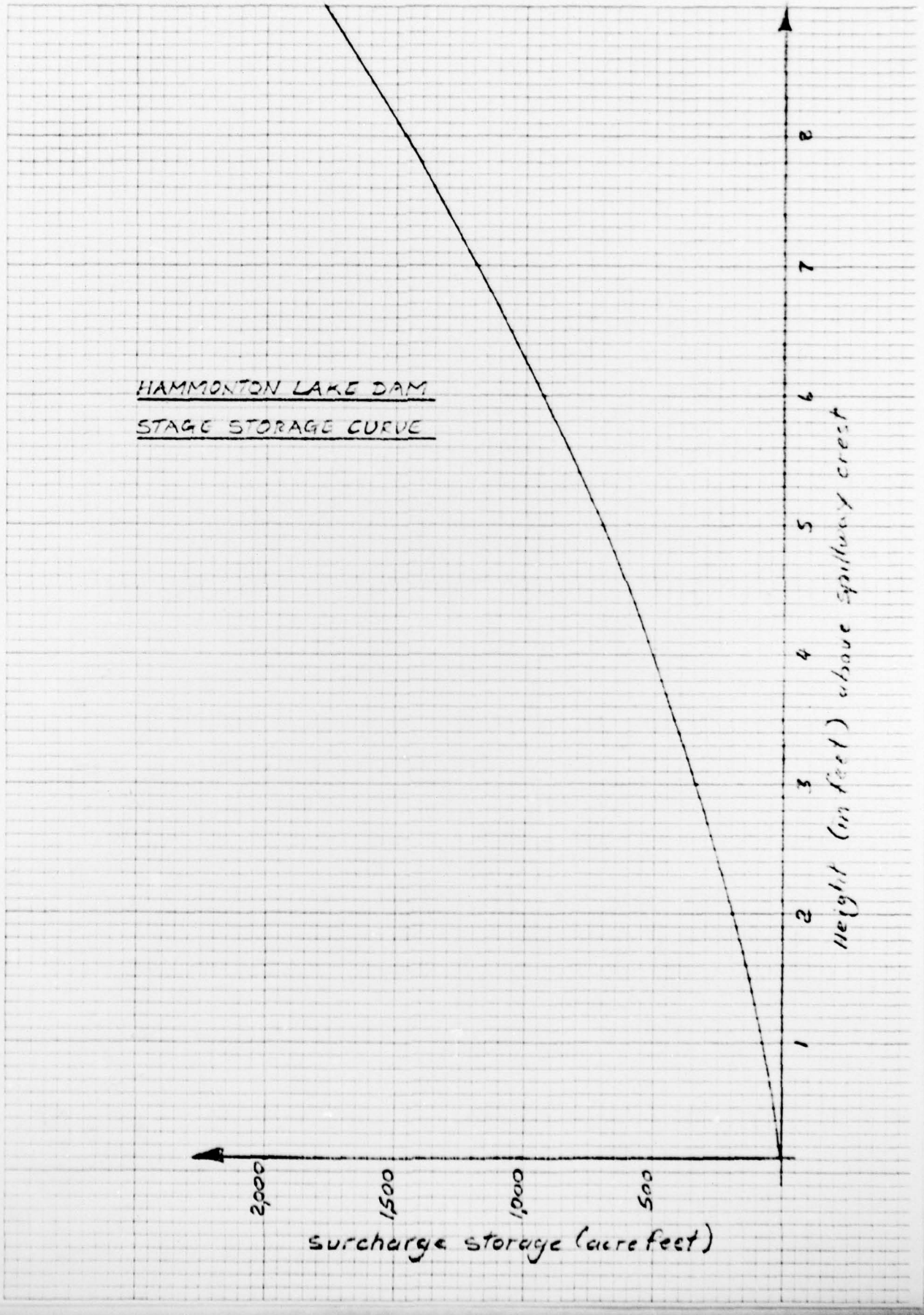
SURCHARGE STORAGE:

Area of lake @ normal pool = 71 acres
Area of lake @ top of dam =
Area of 80' contour = 381 acres



Increment in volume $\Delta V = (x + \Delta x)y$

Height in feet above spillway crest	Surcharge storage (acre feet)
0	0
1	85
1.5	138
2	198
3	340
4	509
5	707
6	933
7	1187
8	1470
9	1780



BY D. J. M. DATE 7-79 | LOUIS BERGER & ASSOCIATES INC. | SHEET NO. 19 OF
CHKD. BY ____ DATE ____ | HAMMONTON LAKE DAM | PROJECT C234
SUBJECT ____

Available head = 8'

Storage @ normal pool = 426 acre feet

Assume drawdown in two stages with no inflow and no tailwater conditions

Stage i) $H = 6'$

$Q \approx 228$ cfs

$$\therefore \text{time} = \frac{426 \times 43560}{2 \times 228 \times 3600}$$

$$= 11.3 \text{ hours}$$

Stage ii) $H = 2'$

$Q = 44$ cfs

$$\therefore \text{time} = \frac{426 \times 43560}{2 \times 44 \times 3600}$$

$$= 58.6 \text{ hours}$$

$$\Sigma \text{ time} = (58.6 + 11.3)/24$$

$$= 2.91 \text{ days}$$

Say 3 days

BY D.J.M DATE

CHKD. BY DATE

SUBJECT

LOUIS BERGER & ASSOCIATES INC.

HAMMONTON LAKE DAM

SHEET NO A10 OF

PROJECT C-234

HAMMONTON LAKE DAM
BY D.J.M.
JULY 17 1979

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	15	0	0	0	0	0	0	0

JOPER NWT
1 0

********** *********** ********** ********* **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	2.70	0.0	2.70	0.0	0.0	0	0	0

PRECIP DATA

NP	STORM	DAJ	LAK
24	0.0	0.0	0.0

PRECIP PATTERN

0.06	0.06	0.07	0.07	0.09	0.09	0.11	0.14	0.30	0.50
0.70	1.70	0.40	0.30	0.16	0.11	0.09	0.08	0.07	0.06
0.06	0.06	0.06	0.06						

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.50	0.10	0.0	0.0

GIVEN UNIT GRAPH. NUHGG= 8

1051.	2537.	1742.	846.	410.	201.	102.	51.

UNIT GRAPH TOTALS 6944. CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.0 QRCSN= 0.0 RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.06	0.00	0.
2	0.06	0.00	0.
3	0.07	0.00	0.
4	0.07	0.00	0.
5	0.09	0.00	0.
6	0.09	0.00	0.
7	0.11	0.04	41.
8	0.14	0.11	219.
9	0.30	0.27	648.
10	0.30	0.27	1.20.

11	0.70	0.67	1599.
12	1.70	1.67	4240.
13	0.40	0.37	6192.
14	0.30	0.27	4912.
15	0.16	0.13	3277.
16	0.11	0.08	2095.
17	0.09	0.06	1332.
18	0.08	0.05	880.
19	0.07	0.05	607.
20	0.06	0.04	411.
21	0.06	0.04	322.
22	0.06	0.04	276.
23	0.06	0.04	257.
24	0.06	0.04	249.
25	0.0	0.0	208.
26	0.0	0.0	118.
27	0.0	0.0	56.
28	0.0	0.0	27.
29	0.0	0.0	13.
30	0.0	0.0	5.
31	0.0	0.0	2.
32	0.0	0.0	0.
33	0.0	0.0	0.
34	0.0	0.0	0.
35	0.0	0.0	0.
36	0.0	0.0	0.
37	0.0	0.0	0.
38	0.0	0.0	0.
39	0.0	0.0	0.
40	0.0	0.0	0.
41	0.0	0.0	0.
42	0.0	0.0	0.
43	0.0	0.0	0.
44	0.0	0.0	0.
45	0.0	0.0	0.
46	0.0	0.0	0.
47	0.0	0.0	0.
48	0.0	0.0	0.
49	0.0	0.0	0.
50	0.0	0.0	0.
51	0.0	0.0	0.
52	0.0	0.0	0.
53	0.0	0.0	0.
54	0.0	0.0	0.
55	0.0	0.0	0.
56	0.0	0.0	0.
57	0.0	0.0	0.
58	0.0	0.0	0.
59	0.0	0.0	0.
60	0.0	0.0	0.
61	0.0	0.0	0.
62	0.0	0.0	0.
63	0.0	0.0	0.
64	0.0	0.0	0.
65	0.0	0.0	0.
66	0.0	0.0	0.
67	0.0	0.0	0.
68	0.0	0.0	0.
69	0.0	0.0	0.
70	0.0	0.0	0.
71	0.0	0.0	0.

72	0.0	0.0	0.
73	0.0	0.0	0.
74	0.0	0.0	0.
75	0.0	0.0	0.
76	0.0	0.0	0.
77	0.0	0.0	0.
78	0.0	0.0	0.
79	0.0	0.0	0.
80	0.0	0.0	0.
81	0.0	0.0	0.
82	0.0	0.0	0.
83	0.0	0.0	0.
84	0.0	0.0	0.
85	0.0	0.0	0.
86	0.0	0.0	0.
87	0.0	0.0	0.
88	0.0	0.0	0.
89	0.0	0.0	0.
90	0.0	0.0	0.
91	0.0	0.0	0.
92	0.0	0.0	0.
93	0.0	0.0	0.
94	0.0	0.0	0.
95	0.0	0.0	0.
96	0.0	0.0	0.
97	0.0	0.0	0.
98	0.0	0.0	0.
99	0.0	0.0	0.
100	0.0	0.0	0.
SUM	5.20	4.24	29606.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6192.	1234.	508.	296.	29607.
INCHES		4.25	4.25	4.25	4.25
AC-FT		612.	612.	612.	612.

HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
11	1	0	0	0	0	1

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTPL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE=	0.	85.	138.	198.	340.	509.	707.	933.	1187.	1470.
OUTFLOW=	0.	30.	49.	73.	128.	149.	1076.	2756.	4925.	7491.

TIME	EOP STOR	AVG IN	EOP OUT
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	0.	0.	0.

BY D.J.M. DATE

CHKD. BY DATE

SUBJECT

LOUIS BERGER & ASSOCIATES INC.

HAMMONTON LAKE DAM

SHEET NO. A13 OF

PROJECT C-254

5	0.	0.	0.
6	0.	0.	0.
7	0.	20.	0.
8	3.	130.	1.
9	12.	433.	4.
10	31.	934.	11.
11	64.	1609.	23.
12	128.	3119.	45.
13	234.	5216.	87.
14	347.	5592.	129.
15	429.	4095.	139.
16	481.	2686.	146.
17	513.	1714.	169.
18	532.	1106.	255.
19	541.	744.	300.
20	545.	509.	320.
21	546.	367.	324.
22	546.	295.	322.
23	545.	266.	317.
24	544.	253.	311.
25	542.	228.	303.
26	539.	165.	290.
27	535.	87.	271.
28	531.	42.	250.
29	526.	20.	229.
30	522.	9.	209.
31	518.	4.	190.
32	514.	1.	172.
33	511.	0.	156.
34	507.	0.	149.
35	504.	0.	148.
36	501.	0.	148.
37	498.	0.	148.
38	495.	0.	147.
39	492.	0.	147.
40	489.	0.	147.
41	486.	0.	146.
42	483.	0.	146.
43	480.	0.	145.
44	477.	0.	145.
45	474.	0.	145.
46	471.	0.	144.
47	468.	0.	144.
48	465.	0.	144.
49	462.	0.	143.
50	459.	0.	143.
51	456.	0.	142.
52	453.	0.	142.
53	450.	0.	142.
54	447.	0.	141.
55	445.	0.	141.
56	442.	0.	141.
57	439.	0.	140.
58	436.	0.	140.
59	433.	0.	140.
60	430.	0.	139.
61	427.	0.	139.
62	424.	0.	138.
63	422.	0.	138.
64	419.	0.	138.
65	416.	0.	137.

LOUIS BERGER & ASSOCIATES INC.

HAMMONTON LAKE DAM

66	413.	0.	137.
67	410.	0.	137.
68	407.	0.	136.
69	405.	0.	136.
70	402.	0.	136.
71	399.	0.	135.
72	396.	0.	135.
73	393.	0.	135.
74	391.	0.	134.
75	388.	0.	134.
76	385.	0.	134.
77	382.	0.	133.
78	380.	0.	133.
79	377.	0.	133.
80	374.	0.	132.
81	371.	0.	132.
82	369.	0.	132.
83	366.	0.	131.
84	363.	0.	131.
85	360.	0.	131.
86	358.	0.	130.
87	355.	0.	130.
88	352.	0.	130.
89	350.	0.	129.
90	347.	0.	129.
91	344.	0.	129.
92	342.	0.	128.
93	339.	0.	128.
94	336.	0.	127.
95	334.	0.	126.
96	331.	0.	125.
97	329.	0.	124.
98	326.	0.	123.
99	324.	0.	122.
100	321.	0.	121.
SUM			14123.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	324.	226.	147.	141.	14123.
INCHES		0.78	2.03	2.03	2.03
AC-FT		112.	292.	292.	292.

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	6192.	1234.	308.	296.	2.70
ROUTED TO	11	324.	226.	147.	141.	2.70